ENERGY OPTIONS

OVERVIEW PAPER

RESIDENTIAL SECTOR

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1. INTRODUCTION

The low-rise residential (LRR) sector contains approximately 7.3 million units or about 90% of the total 8.2 million dwellings in Canada. The LRR sector comprises single-attached and single-detached units, duplexes, row houses, and low-rise apartment buildings. Single-detached units account for approximately 65% of all existing LRR units. Approximately two-thirds of the total existing LRR units are located in Quebec and Ontario.

Over 50% of the Canada's existing residential units have been constructed since 1960, although it is also important to note that nearly a quarter of all existing units were built prior to 1945.

Energy Consumption Patterns: The LRR sector accounts for approximately 16% of Canada's total annual energy consumption, or about 970 petajoules. Space and water heating account for 90% of the energy consumed in this sector with lighting and appliance operation accounting for the remaining 10%.

During the last 5-10 years, many homeowners have reduced the level of energy consumption in their homes through upgrading insulation levels, improving the efficiency of their home heating systems, reducing household temperature settings, installing automatic set-back thermostats, etc. However, despite these initiatives, it is widely accepted that the savings achieved to date represent less than half of the potential savings which can be realized through cost-effective retrofit measures.

The potential for energy savings in new dwellings is even more impressive. However, the large majority of new homes still do not incorporate many cost-effective super energy efficient measures which offer relatively short payback periods.

2. OPTIONS

The major retrofit options can be divided into two broad categories: building envelope and heating/ventilation systems. Available options within each category include:

- **Building Envelope (Existing Housing)**

  - Caulking and weatherstripping (air sealing) offer a relatively low-cost means of reducing heat losses associated with infiltration of unconditioned outside air

  - Increased insulation levels, not only in ceiling/attic areas, but also in walls, basement areas and exposed floor areas offer significant savings

  - Upgrading or replacing thermally inefficient doors and/or windows may be a cost-effective option in certain applications, particularly if co-ordinated with coincident household renovations

  - In certain applications, a complete re-wrap and re-insulation of walls, basements and/or roofs may be cost-effective, particularly if co-ordinated with coincident household renovations

- **Heating, Ventilation and Hot Water Systems (Existing Housing)**

  - Installation of an automatic set-back thermostat offers energy savings without sacrificing occupant comfort

  - The efficiency of existing heating systems can be improved through proper tuning, upgrading or replacement by new high efficiency models

- In well sealed homes, installation of heat recovery ventilation systems incorporating heat exchangers or heat pumps can provide proper indoor air quality with minimum heat loss

- Ground or water source heat pumps can, under suitable site conditions, provide significant savings in space heating costs

- In some cases, conventional heating systems can be supplemented or replaced by heating systems using wood or other available and lower cost fuel sources

- Insulation of hot water lines and storage tanks as well as the installation of water flow restrictors and low water use appliances can reduce water heating costs

. **New Housing**

- New housing offers the potential for even more dramatic energy use reductions than existing housing. New super energy efficient housing, constructed to R-2000 standards, can reduce heating costs by as much as 90% in comparison to an average Canadian house constructed according to the conventional standards of the 1970's.

3. CREDA Demonstrations

The federal/provincial or territorial Conservation and Renewable Energy Demonstration Agreements (CREDA) supported the projects outlined below which provide a sample of the various options for reducing energy consumption and/or costs in the residential sector. They not only provide tangible evidence of the very significant energy cost savings that can be realized in the residential sector but also provide practical installation and operation experience.

The demonstration projects contained in the **ENEROPTIONS** package are:

MAN 43 Two Town Retrofit - Pinawa and Stonewall, Manitoba

To demonstrate the level of conservation implemented after home and building owners are given detailed instructions, detailed energy audits were performed in more than half the buildings in two Manitoba towns. To encourage participation and a sense of community involvement, an energy conservation competition was staged between the two towns. Combined annual energy savings of 7% to 10% (exclusive of savings in transportation) were demonstrated for the two towns. This added up to a two town annual savings of about $170,000.

YUK 20 Senior Citizen Residential Retrofit Program - Throughout Yukon

90 senior citizen homes and apartments received an energy audit, of which 56 homes received retrofit measures carried out by contractors specially trained for the work. Retrofit measures ranged from simple air sealing and heating system tuning to complete building re-wrap, resulting in savings from 10% to 65%.

YUK 21 Skookum Jim Friendship Centre - Whitehorse, Yukon

Ten carpenters from native communities throughout the Yukon were selected to represent their Bands in an eight-month energy conservation training program. Participants received formal classroom training and gained practical experience by retrofitting and renovating a 22 year-old building, the Skookum Jim Friendship Centre. The retrofit reduced the heating bill by over 75% on a unit volume basis. The carpenters then retrofitted over 40 homes in Yukon native communities.

NWT 17 New Super Energy Efficient Town houses - Yellowknife, N.W.T.

Fifty new town houses were built to R-2000 energy efficiency standards. Features incorporated included southern orientation, high insulation levels, sealed air-vapour barriers, poly electric boxes, air-to-air heat exchangers, enclosed propane furnace area, triple-glazed windows and insulated crawl space. These units used 75% less energy than conventional townhouses.

NB 50 Groundwater-Source Heat Pumps - New Brunswick

Groundwater-source heat pump systems were installed in homes and a small commercial building as an alternative to conventional oil-fired systems for heating. Annual savings range between 64% and 73%.

NB 58 Residential Surface Water Source Heat Pump - New Brunswick

Surface water source heat pumps were installed in two New Brunswick homes to supply space heating and domestic hot water requirements using in one case the St. John River and in the other an adjacent pond as a heat source. Annual savings are 63% and 72% respectively.

Many other projects of interest have been undertaken. Contact your nearest federal or provincial energy office to learn more about nearby projects or those in applications similar to yours.

4. LESSONS LEARNED

- **Building Envelope (Retrofit)**

  - The effectiveness of residential retrofit measures is strongly influenced by a variety of factors. The CREDA demonstrations have, in particular, identified four factors:

- an accurate knowledge of the building, preferably based on an energy audit
- careful selection of retrofit measures
- an informed homeowner/occupant
- well-trained retrofit contractors

- Cost-effective savings of up to 50% can be achieved through major retrofit of existing buildings. However, the simple payback period for specific retrofit measures can vary from as short as a few months to 12 years or longer. This variation in payback periods reinforces the value of an energy audit or other house-specific advice prior to the selection of retrofit measures

- Air sealing (reducing air exchange rates) is a more important retrofit technique than earlier assumed. Air exchange can account for between 20 and 40% of heat loss. How far to go in sealing a house is, however, a controversial issue due to concern over humidity problems, combustion air supply and indoor air quality. In some cases, the energy savings from air sealing have been eroded significantly by occupant behaviour (e.g., opening windows in response to higher humidity levels).

- Despite the public information efforts of the past several years, there remains a need for better homeowner information related particularly to the selection of retrofit measures and products as well as proper post-retrofit occupant practices (e.g., to operate kitchen and bathroom exhaust fans to help control humidity levels rather than open windows, etc.).

- Major retrofits can involve a significant capital investment; consequently, some form of financing should be available to homeowners to assist them to spread the retrofit costs over the payback period.

- There is a need for futher contractor training and certification for the specialized aspects of super energy efficient retrofit. Specialized aspects include:
  - techniques for modifying the existing structure to accommodate high insulation levels
  - techniques and application procedures for achieving air tightness
  - improved construction detailing and job costing accuracy

- **Heating/Ventilation Systems (Retrofit)**

- Automatic set-back thermostats generally have a payback period of less than 1 year. Experience has show that, if the thermostat is set back for an 8-hour period each night, an average saving of 2% of space heating costs is realized for each degree Celsius that the temperature is lowered.

- Annual fuel savings of up to 15% are possible through upgrading the seasonal efficiency of oil-fired heating systems. Upgrading of gas furnaces is constrained by existing provincial gas regulations which normally limit changes to be made to a gas furnace or boiler after it has left the factory.

- Some of the currently available heat exchanger units have experienced problems with:
  - poor cold weather performance
  - insufficient capacity
  - unbalanced air flows

  These problems are being corrected through manufacturer design improvements and in response to the development of heat recovery ventilation (HRV) related CSA standards

- Simple payback periods for ground and river-source heat pump systems appear to be less than 7 years. Paybacks for groundwater-source heat pumps can be reduced if the supply well is used to provide domestic water.

. **New Housing**

- Super energy efficient housing, which uses 75% less energy than conventional buildings, can be economically and practically built in northern Canada. Payback periods of under four years appear possible. However, in northern applications, moisture control is particularly critical.

5. NEXT STEPS

The demonstration case studies contained in this **ENEROPTIONS** package present some of the many options which are applicable in the residential sector. It is hoped that they will benefit you by:

. indicating applications that may be relevant to you or your organization

. presenting an accounting of actual experience -- both actual benefits and actual problem areas, if any, that you can expect should you pursue a similar initiative

To assist you, several "next steps" are suggested below.

. **All Applications**

- Contact the appropriate demonstration project managers and resource persons listed in the case study of interest. These persons are listed not only because they are familiar with the project but also because they are ready and willing to discuss their experience with you. In other words, "don't re-invent the wheel".

- **Existing Housing**

  - Invest in an energy audit before specifying the retrofit measures to be carried out. The "Resources Available" section (below) presents several available options for securing an energy audit. Depending on your circumstances, the cost for this service can be minimal, but, as previously emphasized, the benefits, in terms of financial return, can be significant.

  - After carefully identifying the retrofit measures and/or heating system changes which are most advantageous to you, obtain cost quotations from at least two or three experienced and qualified contractors.

- **New Housing**

  - Ensure that you are thoroughly familiar with super energy efficient building standards; shop carefully for a list of qualified and experienced architects and builders.

6. RESOURCES AVAILABLE

Technical reports are available free of charge for most of the CREDA project listed above. Addresses of appropriate contacts for follow-up are listed at the end of each of the attached ENEROPTIONS case studies under the "Further Information" section.

The departments or ministries of energy in each province or territory have information on energy conservation and renewable energy and may have assistance programs. Check your telephone directory for appropriate contacts.

Do-it-yourself energy audits can be carried out using the Ener$ave computer service available through your provincial/territorial Conservation and Renewable Energy Office (CREO) of Energy, Mines and Resources

Canada. Information on the Super Energy Efficient Housing (SEEH) Program and the Buildings Energy Technology Transfer (BETT) program is also available from the CREOs. Check the back of the attached file folder for the office in your area.

More sophisticated energy audit services are available from consulting firms and building contractors. Qualified individuals and firms can be identified through contacting:

- Canadian Home Builders Association
  Suite 400
  20 Toronto Street
  Toronto, Ontario
  M5C 2B8
  (416) 364-4135

- The Association of Consulting Engineers of Canada
  Suite 616
  130 Albert Street
  Ottawa, Ontario
  K1P 5G4
  (613) 236-0569

  or the consulting engineering organization in your province.